SUMMARY

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SUMMARY: OPPORTUNITIES FOR RESEARCH WITH SMALL TELESCOPES

J. A. Graham
Carnegie Institution of Washington
Department of Terrestrial Magnetism
Washington, D. C.
U. S. A.

Our meeting has been unusual in that we have covered so many fields of present-day astronomy and astrophysics. The common link has been the potential of small telescopes for making substantial advances in our knowledge of the observable universe. Attention has been focussed not just on those programmes which can be done best with small telescopes but we have also highlighted many which can only be done with small telescopes.

At this IAU symposium, we followed the by now almost established format of having a number of invited review papers with the bulk of the contributed papers in poster format. The invited papers served to bring us up-to-date on what had been done in the various research areas. However, most of the new results appeared at the poster sessions. Our three poster discussion periods worked especially well through the efforts of the excellent chairmen, Dave Latham, Brian Warner and Bob Garrison. There were several lively discussions with question and answer exchanges which compelled many of us to go back for a second look at many of the posters. I particularly liked the practice followed by many of photographing posters so that the new ideas displayed there could be carried back to the people at home who were not able to be with us in New Zealand.

One's main job in attempting a summary such as this is to try and sense the main themes running through the meeting. Perhaps a major one was that astronomy is a science which is in no way problem limited at present. Rather the limit seems to be determined by the number of people who are able to undertake research in the different fields. In his splendid overview which started off proceedings, Brian Warner reminded us that, with small telescopes, discoveries can and have been made which opened up whole new research areas. He gave several examples and many of us felt we could have added to his list.

There is an abundance of new instrumentation available. New detector technology was reviewed by Dave Latham. Some of it is expensive both in terms of money and time and should not be undertaken without careful

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planning. However, the benefits are enormous. With CCD detectors, for example, photometry and spectroscopy of faint objects are no longer just in the realm of large telescopes at a few institutions. However, their use does require a major effort. Why do we do it? It is very much the old spirit of exploration as we try to push back the boundaries of knowledge a little bit further. Our standards are high! As Latham reminded us, "If you can satisfy an astronomer you can satisfy anyone."

With modest, conventional instrumentation, progress can still be made. However, the path is not so direct. Here, the effort sometimes has to be put into programmes which cover a long period of careful observation often extending over many years. The results can be of fundamental value and can equally well determine directions of future research. Hugo Levato summed it up nicely when he said, "A modest budget does not have to mean a modest institution." It is the scientific creativity which counts.

In the instrumentation line, many new telescopes of the 0.5-1.5 m class are coming into use. Several were described in the posters. We all welcomed the University of Canterbury 1 m telescope and look forward to its inauguration during 1986. Automatic telescopes have come among us, this time to stay. Russ Genet and others showed what fine work the amateurs have been doing here. Paul Payne described the automatic patrol camera being developed at the University of New South Wales.

A number of new instruments were described which took advantage of new technology. I was especially impressed by the photometers and spectrographs which incorporate the relatively cheap but very efficient fibre-optic feeds which are now available. A. K. Saxena described a new polarimeter with a CCD detector which he is building at the Indian Institute of Astrophysics. Costs and effort in getting a CCD system into operation on a small telescope were described by Bryan Laubscher of the University of New Mexico while Ben Peery told us about the off-the-shelf Reticon system he had obtained for Howard University. With the accurate linear detectors now available, the distinction between spectroscopy and photometry is indeed becoming diffuse. Several radial velocity spectrophotometers, for example, were described at the meeting which are producing velocities to an accuracy better than 1 km s^{-1}.

Many new observing opportunities were described. A prominent theme, reiterated again and again by participants, was the tremendous amount of work still needing to be done on the apparently brightest stars which are difficult or impossible to observe with large telescopes. Information about diameters, multiplicity and even the shapes of stars comes from the study of occultations by the moon. After David Evans's review, Wayne Osborn pointed out to me that this is a particularly good field in which to get involved if one is attached to a physics department. Not only is the relatively high-tech equipment usually available but also there are students freshly acquainted with the concepts of signal and noise; important ones in this work.

With telescopes which can be set rapidly and accurately, large survey programs can be carried out to give good statistical samples of many thousands of stars. B. Twarog of the University of Kansas showed us how photometry of such samples can give important information on the history of galactic star formation. W. Gliese of Heidelberg reminded us several times about how incomplete our knowledge is of the 1000-2000 nearest stars.

Alistair Walker from Cape Town talked about the methods of CCD photometry. With this technique, one can produce better photometry for stars of 12th mag and fainter than by any other means. Photometry done with small telescopes complements and essentially ties down photometric work carried out with large telescopes.

All through Tuesday, Thursday and Friday we were reminded of the importance, particularly in the southern hemisphere, of observation of binary stars. Visual binaries, spectroscopic binaries, eclipsing binaries and contact binaries all competed in their own way for our attention in the talks by Batten, Plavec and Rucinski. Much of this can be done with small telescopes. Photometry, spectroscopy and radial velocities are all needed. Small, dedicated telescopes can undertake fundamental programs. Brad Wood, speaking about eclipsing binaries, reminded us, "If you want to achieve immortality, observe times of minimum and publish them." His statement can be readily adapted for application to other fields although a certain amount of the appropriate insight and intuition is necessary.

In this symposium, we have talked mostly about stars but valuable work can be done with small telescopes on solar system objects (A'Hearn, Schober, Millis) and on external galaxies (Djogovski, Phillips). Telescopes with short focal lengths must be used, for example, to get representative spectra of extended objects like comets and nearby galaxies.

I am deeply conscious of not being able to cover all the highlights of this meeting which has embraced so much. For instance, I have not reviewed the many opportunities for MK spectral classification and the development of the MK process as related by Hugo Levato and Bob Garrison. However in the available time, I would like to reiterate two subjects brought up during the meeting by W. Wisniewski and M. Zeilik. First, it is very clear that, with the expansion of space astronomy, ground-based support and follow-up is going to be needed urgently. We should be opening up more small telescopes, certainly not closing them. Arthur Page reminded us that here on cloud-bound Earth, any one small telescope may be in a unique position to obtain further coverage of a special event observed from space. Then, as Mike Zeilik told us, we have to worry about funding. Government money will remain tight unless we can get out and demonstrate the importance of astronomy to the people who control its distribution. Especially

in the United States, astronomers have been successful in the past in getting help from industrial groups and in turn helping them to push their techniques to the limit. In the long run, they, as well as we, have benefited. As I see it, more countries could follow this track. It is this characteristic of forever pushing towards greater limits which has made astronomy such an exciting field in which to work for so many of us.

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